RAILWAY ENGINEERING

AND MAINTENANCE OF WAY

Vol. IV AUGUST, 1908 No. 8

Railway Engineering

and Maintenance of Way

PUBLISHED BY
CRANDALL PUBLISHING COMPANY

BRUCE V. CRANDALL, President WARREN EDWARDS, Vice-President C. C. ZIMMERMAN, Secretary
NORMAN F. REHM, Editor

OFFICE OF PUBLICATION: Security Building, Cor. Madison St. and Fifth Ave., CHICAGO Telephone Main 3185

Entered as Second-Class Matter April 13. 1905, at the Post Office at Chicago, Illinois, Under Act of March 3, 1879.

THE ADVANCE AGENT

¶ The gradual increase in the demand for railway supplies is being sustained. One railroad shop after another is employing a full force of men and running regular hours. The railroads throughout the country, though more particularly the western roads, are getting their equipment in shape to handle the heavy crops. To the excellent agricultural conditions that exist may be credited the steady resumption of business.

¶ The market may be quiet but will not remain so very long. It has been many months since large purchases of railway supplies have been made but the wear and tear of equipment has continued. Even if the traffic of railroads did not equal the amount of recent years, it would still be necessary to replace worn out equipment.

¶ Now is the time to advertise. The need of keeping your products at all times before the railway officials is apparent and it is certainly good policy. Is it not even more necessary to advertise your supplies when the buyers are getting ready to close deals? Think about this side of the question when you are cutting down your expenses. Your investment in a publicity campaign at this critical period will insure your share of the business.

CLASSIFIED INDEX OF ADVERTISERS

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A Monthly Railway Journal

Devoted to the interests of railway engineering, maintenance of way, bridges and buildings.

Communications on any topic suitable to our columns are solicited

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Convention of Railway Telegraph Superintendents

THE twenty-seventh annual convention of the Association of Railway Telegraph Superintendents was held recently in Montreal. It is gratifying to note that the attendance at this meeting was the largest since the organization of the association. There is no doubt that the future efforts of the officers and members in increasing the membership and extending the influence of the association in betterment work will meet with success.

The first paper to come before the convention was that of W. W. Ryder on "The Telephone in Railroad Service." This paper, which treats of the gradual substitution of the telephone for the telegraph in handling trains and explains the advantages to be obtained with the new system, is printed elsewhere in this issue. Mr. Ryder gave a list of twelve roads using telephones for train despatching, covering a total mileage of about 5,700. Following upon this paper experiences in the introduction of the telephone were related and discussions on telephone train despatching were continued throughout the day.

On the second day Joseph P. Church, chief clerk of the Wabash telegraph department, presented a paper on "Commercial Reports." This was followed with a paper on "Reduction of Telegraphing by Use of Printed Forms," by O. C. Greene, superintendent of telegraph of the Northern Pacific. Mr. Greene gave the objections to a multiplicity of forms and suggestions as to proper revisions to secure efficient service.

At the 1907 convention a paper on the "Dry Battery for Block Signal Wires" was presented by U. J. Fry, superintendent of telegraph of the Chicago, Milwaukee & St. Paul. Mr. Fry presented a paper on the "Dry Battery" to this convention and gave further data regarding its use on his road. He finds after three years' service on the block wire between Brookfield and Waukesha that the dry battery operation costs about $2.18 per mile per year less than the storage battery.

The effects of legislative action on the railroads were considered in a paper on "Adverse Railroad Legislation," by E. A. Chenery, superintendent of telegraph of the Missouri Pacific. The next paper was by W. F. Williams, superintendent of telegraph of the Seaboard Air Line, who discussed the "Past, Present and Future of the Association."

A paper on "Qualifying Operators for Train Despatching" was read next by C. S. Rhoads, superintendent of telegraph of the Lake Erie & Western. Mr. Rhoads believes in a most rigid examination of applicants for the position of train despatcher on account of the large responsibilities attached to the office and explains in detail the qualifications. I. H. Jacoby read the next paper on "Wiring of Station Buildings From the Contractors' Standpoint." A paper on "Wireless Telephony," by William Maver, Jr., was read and in the discussion L. B. Foley, of the Delaware, Lackawanna &

Western, stated that the wireless telephone system had proved satisfactory on his road between points two miles apart.

Messrs. G. A. Cellar, G. H. Grace, G. W. Dailey, E. H. Millington and Charles Seldon were appointed a committee to consider the question of high tension wires crossing railroads. It was the general opinion that uniform legislative action should be had in every state on account of the many dangerous crossings of railroads by foreign wires.

William J. Camp, of the Canadian Pacific, was elected president for the ensuing year; G. W. Dailey, of the Chicago & Northwestern, vice-president, and P. W. Drew, of the Wisconsin Central, secretary and treasurer.

Railroad Accidents.

WHILE the total number of casualties to passengers and employes in the months of January, February and March, 1908, is smaller than in any quarter since the one ending March, 1905, the number of employes killed in coupling accidents for this first quarter of 1908 is smaller than any since July, 1901.

For the quarter ending March, 1908, there were 44 killed in coupling accidents; for the quarter ending December, 1907, there were 77; and for the quarter ending March, 1907, there were 62. Of the 44 there were 13 trainmen, 5 trainmen in yard, 23 yard trainmen (switching crews) and 3 other employes.

In Accident Bulletin No. 27, of the Interstate Commerce Commission, from which the above record is taken, it is stated that the reduction in deaths and injuries are due principally to the reduction in traffic resulting in easier work and shorter hours. The large reduction is an indication of the possible results to be secured through a larger and more efficient force of employes.

The chief cause of coupling accidents, resulting in death, were coupling damaged cars, miscalculated speed, lost footing and mistakes in hand signals. The injuries not fatal were due mainly to adjusting coupler with foot, getting fingers or hand caught between uncoupling lever and body of car, uncoupling without using lever, miscalculated speed and unexpected movement of car.

In the quarter ending March, 1908, there were 1,190 collisions and 1,442 derailments, giving a total of 2,632. For the same period of 1907 there was a total of 3,991 collisions and derailments. The causes for 13 of the more prominent collisions were mistakes in delivering or receiving dispatcher's orders except in a few cases. The causes for 13 prominent derailments were broken rails, broken wheels, soft roadbed, defective track, malicious obstruction, etc.

Railroad Extension

AN abstract of statistics from the Interstate Commerce Commission report on the railways for the year ending June, 1907, shows a large increase in mileage, equipment and employes. Both gross earnings and operating expenses increased heavily.

The total single track mileage on June 30, 1907, was about 230,000, or about 5,600 miles more than the previous year. Particularly in the southern and western states railway extension was in progress. The mileage, including all tracks, was about 328,000, an increase of about 10,900 miles.

There were in service on June 30, 1907, about 55,400 locomotives, the increase being 3,716. The total number of cars was about 2,126,600, the increase being 167,682. The average number of locomotives per 1,000 miles of line was 243 and the average number of cars per 1,000 miles was 9,350.

On June 30, 1907, there were on the pay rolls about 735 employes per 100 miles of line. The increase over the previous year was about 51 employes per 100 miles of line. The total number of employes was about 1,672,000, and the total wages paid about $1,072,386,000.

The number of passengers carried during the year ending June, 1907, was about 874,000,000, an increase of about 76,000,000. The passenger mileage was about 27,719,000,000. The tons of freight carried was about 1,796,000,000, the increase being about 165,000,000. The ton-mileage was about 236,600,000,000. The average revenue per passenger per mile was 2.014 cents and per ton per mile was 0.759 cent.

The above figures indicate the prosperous condition of the country as well as the railroads in the year previous to the financial stringency. There is no doubt that in a comparatively short time the business of the railroads will approach the mark of the year ending June, 1907, and that railroad construction will be as extensive, if not more so.

Several Important Reports.

AT the recent annual meeting of the American Society for Testing Materials, numerous committee reports of especial interest to railroad men were presented. The steel rail question, the corrosion of iron and steel, steel column tests, preservative coatings for iron and steel and cement and concrete were among the topics discussed at the convention.

The presidential address of Dr. Charles B. Dudley dealt with features of the steel rail question. He discussed the influence of increased speed on the life of rail, the increase in wheel loads, the increase in traffic and then took up the question of increased weights of rails, the development of rail sections, track and roadbed. He also refers to the manufacture of steel rails, the present specification, the present knowledge of steel rail manufacture and the work before the engineering associations. It is difficult to give a clear idea of the important address of Dr. Dudley and to indicate in a few words how he has summed up in brief form the present steel rail situation.

The committee on Standard Specifications for Iron

and Steel reported in favor of a drop test from every blow of steel for rails from 85 to 100 lbs. and also the rejection of all rails failing to pass the standard drop test, as No. 2 rails. A doubt was expressed by the committee as to the value of the present standard drop test, but the committee did not suggest changes in view of uncertainties that still exist in the proper design and manufacture of drop-testing machines.

Supplementing the committee report and Dr. Dudley's discussion there were many other papers dealing with the steel rail question. Metallurgical investigations, manganese sulphide as a cause of rail failure and failures from split heads were discussed in various papers.

The report of the committee on the corrosion of iron and steel brought out some important points, mentioned below. Evidence from various investigators appears conclusive that corrosion is an electro-chemical phenomenon. The committee and the American Steel & Wire Company have arranged for co-operative tests. Tests are now under way to discover the ability of certain pigments to prevent corrosion, steel columns under the steel pier at Atlantic City being used. The standard acid bath test can not be used as a basis to determine the relative values of metal manufactured by different processes.

Several papers were offered on the subject of corrosion of iron and steel, among which was a paper by Dr. A. S. Cushman on "Electrolysis and Corrosion." In this paper attention is called forcibly to the injurious effects of the presence of impurities in an inhibiting paint.

At the Watertown arsenal steel column tests are now under way. Standard and special tests will be conducted on members of rolled and built sections designed and manufactured in accordance with present practice. After these government tests on steel columns are completed, it will be possible to design large bridge compression members with a higher degree of certainty.

The committee on Preservative Coatings referred in the report to the service tests of 57 paints on the Havre de Grace bridge of the Pennsylvania railroad. The report states that these paints are in general giving good protection, but that it is not possible to differentiate as yet as to their values. Several other tests now under way were mentioned in the report.

The subject of cement and concrete received considerable attention. The report of the committee on Standard Specifications for Cement contained several amendments to the present specifications and these amendments are to be voted upon by letter ballot. There were also numerous papers on cement and concrete, some of which were descriptive of tests that have been made recently.

A Test of Large Reinforced Concrete Beams

By Arthur N. Talbot*

THE test here described will be of interest to engineers because the reinforced concrete beams were chosen almost at random from a large number of beams made up for use in a railroad structure and thus may be considered to be representative of actual conditions of construction, and because the tests give a comparison of the efficacy of two methods of placing the reinforcement to resist diagonal tension or so-called shear failures. The beams were perhaps the largest reinforced concrete beams yet tested, and the testing apparatus used and the method of making the test involved some novel features. The beams were tested in the yards of the Illinois Central Railroad at Twenty-Seventh street, Chicago, close to the point where they were made. The beams were in the form of slabs 25 ft. long, 6 ft. 3 in. wide, and 34 in. deep at the middle, and weighed about 33 tons apiece. They were built for use in the floors over the subways of the Grand Crossing track elevation work now in progress of construction. The slabs span the distance from the curb to the center of the street pavement, making a floor over the street upon which the ballast is spread and the track laid for the eight track railway. The tests were undertaken through the co-operation of the Engineering Experiment Station of the University of Illinois and the Illinois Central Railroad to determine the properties of large beams made under practical conditions. As this is one of the largest and most important pieces of construction of the kind yet made, it seemed desirable to make tests of the slabs before putting the structure into service.

The slabs were built by the Illinois Central Railroad Company's force. The concrete was composed of 1 part cement, 2 parts sand, and 5 parts unscreened limestone. The concrete was machine mixed and was made wet so that little or no tamping was required. Owl Portland cement was used. Tests of the cement gave a tensile strength of 822 lb. per sq. in. for the 7-day neat test; 95.2 per cent passed the No. 100 sieve. The longitudinal reinforcement was 1-in. corrugated bars. Tests made by Robert W. Hunt & Co. on bars selected from those used on the work showed an elastic limit of 52,000 lb. per sq. in. Twenty-nine of the 1-in. bars were used in the width of 6 ft. 3 in., the spacing being made 2½ inches center to center; and as the distance from top of slab to center of bars at the middle of the beam length was 30½ in., the reinforcement was about 1.25 per cent. Two forms of bending up the bars at the ends were used. In No. 70, which was the last slab made in this way, the bars were bent up at an angle of about 45 degrees rather close to the end, the bend for one-fourth of them

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*University of Illinois, Urbana, Illinois.

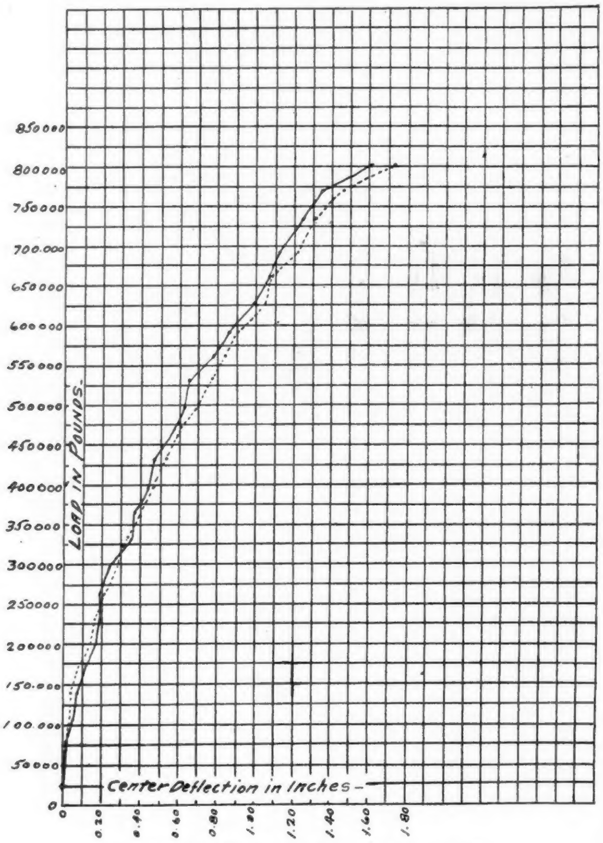


FIG. 1—DEFLECTIONS OF NO. 70 AND NO. 71.

starting at about 2 ft. from the end, for another fourth at 3 ft., for another fourth at 4 ft., while the remaining bars were straight throughout the length of the slab. No stirrups were used in No. 70. In the slabs made after No. 70, (including No. 71 and No. 72, which were tested) stirrups were used and the bars were bent up farther back from the end and less abruptly, as is seen in the figure showing the position of the beams in the test. In one-fourth of the bars the inclination started at a point 6 feet from the end, in one-fourth 4 feet from the end, and in one-fourth 2 feet from the end, while as before the remaining bars were horizontal. In these slabs U-shaped stirrups made of ½-in. corrugated bars were placed vertically at distances of 2½ ft., 4 ft., 5½ ft., and 7 ft. from the ends of the slabs. Each stirrup passed under and included five reinforcing bars and reached nearly to the top of the slab. In addition to the bottom reinforcing bars, 4 ½-in. cup bars were placed longitudinally 3 inches from the top of the slab; and transversely across the slab 2 inches below the top were 12 ½-in. and 6 1-in. bars, while transversely across the bottom longitudinal reinforcement were 21 ½-in. bars. At the middle of the width of the slab and at 2 ft. 6 in. from either end heavy steel stirrups were inserted; these were used to fasten the lifting device to when the slabs were lifted and moved. The slabs tested were made Oct. 7 and 8, 1907. No. 70 was tested April 15 and No. 72 April 28, 1908. In the meantime they were left just where made and were exposed to the weather. Although they were over six months old, the setting of the concrete during the winter weather must have been slow, and the conditions would be less favorable than is usual for 90-day test beams.

The tests were made as follows: One slab was placed above another (the lower one having been turned upside down) with a bearing between them at their ends. Two yokes were placed at the one-third points of the span length, and four hydraulic jacks acting on the yokes were operated to force the slabs together. It will be recognized that their great weight made the placing of the slabs a considerable undertaking. They were handled by means of a derrick car of 100 tons capacity, and although this was the first experience of the men in handling the slabs the derrick and the holding device did the work easily and satisfactorily. In inverting slab No. 71, however, the great weight on one rail caused one side of the temporary construction track to settle considerably; and to avoid possible overturning of the derrick car, the hoisting cable was slackened suddenly and the slab was dropped, falling 4 feet and striking on a pile of stone and against a rail. One corner of the slab was cracked, but so far as the tests show no other injury was done.

The lower slab was supported on 12x12-in. timbers placed transversely across the slab at about 4 feet from the ends. At either end a 12x12-in. oak timber was placed across the slab, the distance from center to center being 23 ft. 6 in., this distance being considered the span length in the test. The other slab was then placed right side up on top of these bearing timbers. The timbers were bedded in plaster of paris above and below in order to overcome small irregularities in the surfaces of the slabs. At the one-third points of the span length 7x14-in. yellow pine timbers were placed on top of the upper slab and also on the under side of the lower slab, and bedded in the same manner. Two 24-in. steel girders were placed at each one-third point on top of the timbers of the upper slab, and similar steel girders at the corresponding points below. Sixteen wrought-iron rods (4 rods at each of the four points) and thick cast-iron blocks were used to complete the connections. The hydraulic jacks were placed between the upper girders and the upper cast-iron blocks. Each jack had an individual pump and gauge. The jacks and gauges had previously been calibrated; the loads given include the necessary corrections. The load was applied in varying increments, but the amount was kept equally divided among the four jacks. The timber pieces formed adjustable bearing plates over the unevenness of the slabs, and there was evidently a good distribution of the load over the full width of the slabs. It seems sufficiently accurate to consider the distance from center to center of supports as the span length. In general, it may be said that the action of the jacks, the uniformity of the results and other circumstances indicate that the testing apparatus was trustworthy within the limits which may be considered necessary for the purposes of the test.

In the first test the only measurements taken were

the deflections of the slabs. The high wind prevailing at the time of the test made it impracticable to use the apparatus provided, and the deflections measured were the sum of the deflections of the upper and lower beams. It is probable that the individual deflections of the slabs were nearly the same except near the end of the test. In the second test the deflection of each beam was measured, and extensometers were used to determine the lengthening and shortening of the beam and the position of the neutral axis. A second set of extensometers was placed in a vertical position to determine when there was a noticeable increase in vertical distance, as would be the case upon formation of horizontal or diagonal cracks across the line of measurement.

The results of the tests are given in the table and diagrams. The diagram (Fig. 1) gives the combined deflections of No. 70 and No. 71. The following are notes of the test of No. 70. It should be borne in mind that the condition of the surface of the slab was not favorable to the early discovery of cracks.

25,000 lb.—This load is assumed to be weight of testing apparatus, men and initial tension on rods.
333,000 lbs.—First tension crack at center of top slab.
364,000 lb.—Small tension crack at north load of top slab.
432,000 lb.—Second tension crack near center of top slab.
468,000 lb.—First diagonal crack outside north load.
496,000 lb.—Numerous small tension cracks.

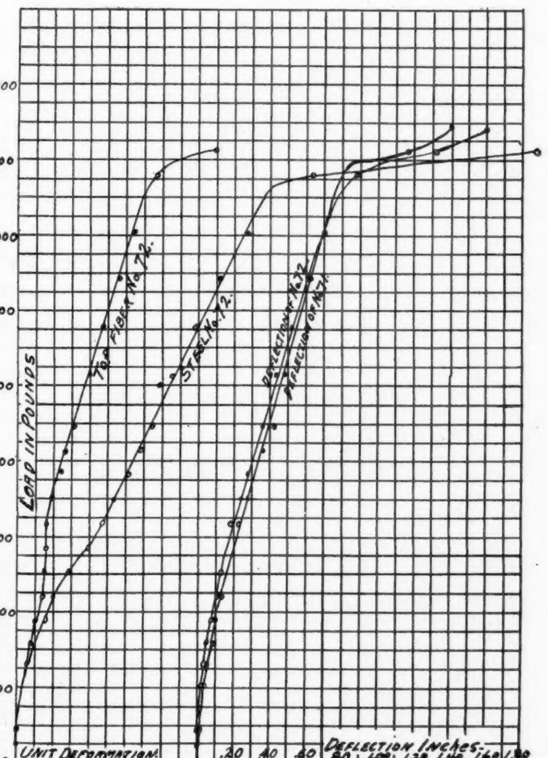


FIG. 2—TESTS OF FLOOR SLABS NO. 70 AND 71—LOADS, DEFLECTIONS AND UNIT DEFORMATION.

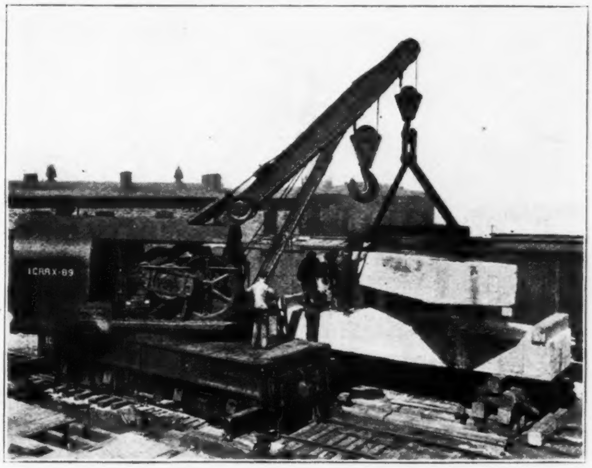


FIG. 3—100-TON DERRICK CAR SETTING TOP SLAB IN PLACE.

593,000 lb.—First diagonal crack lengthening rapidly and becoming more marked.
626,000 lb.—Cracking along the steel at south end.
693,000 lb.—In the interval after 488,000 lb. other diagonal cracks appeared near the first.
734,000 lb.—First diagonal crack opening wide.
801,000 lb.—Failed suddenly along first diagonal crack, which reached top just inside the load point.

The results of the test of No. 72 are given in Table 1 and in the diagram (Fig. 2). The calculated stress in the steel is based on the formula for resisting moment, $0.87\ Afd$,, where A is the area of the reinforcing bars, f is the stress, and d is the distance from top of slab to center of bars, called here 30½ in. The surfaces of No. 71 and No. 72 were coated with whitewash and marked off in 6-in. squares, and the position of the cracks at the different loads was noted and traced in pencil as the test progressed. The cracks were afterward painted with black paint and hence appear greatly magnified in the photographs. The numbers on the photograph mark the limit of the cracks at the applied load given for the same number in Table 1. These numbers permit the growth of the cracks to be traced. The smooth white surface permitted the cracks to be seen while very small, and the tension cracks in No. 72 were noted at much lower loads than in No. 70, which had not been whitewashed. The measurements on the lower slab, No. 71, in the second test were made with a type of instrument which is not entirely suitable for this form of test, and as the results are somewhat irregular, they are not given here. The readings of the vertical extensometers showed a marked increase in the later stages of the test and will be referred to in the discussion of diagonal failure.

As is usual in such tests, minute cracks become visible in the concrete on the tension side of the beam between the load points as the load was applied and on the outside of the load points at higher loads. These cracks grew in height and became more marked as the load was increased. In the first test (No. 70 and No.

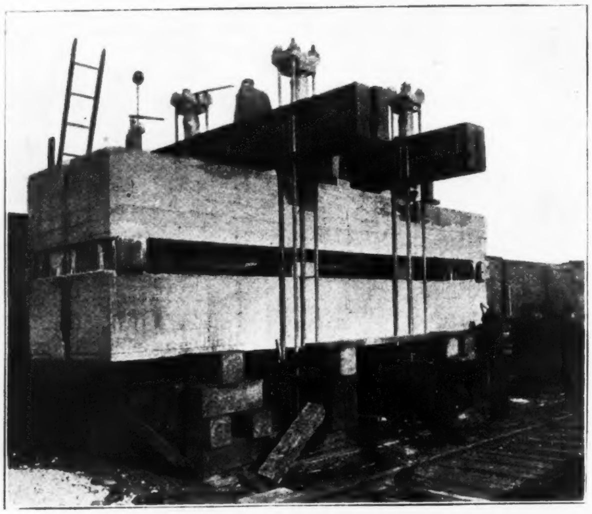


FIG. 4—SLABS AND LOADING APPARATUS IN PLACE.

71 together), in which the beams did not fail by the reinforcing steel stretching up to the yield point, these cracks closed up upon the release of the load to such an extent as to be scarcely detectable. In No. 70 (not whitewashed) the first tension crack was noted at an applied load of 333,000 lbs. and numerous tension cracks at 496,000 lbs. In No. 72 (whitewashed surfaces), the first tension crack was noted at 159,000 lbs. and numerous tension cracks at 189,000 lbs. It will be seen from the photographs that some of these minute cracks reached points 12 ins. from the top of the slab before the reinforcement was stressed to its yield point. Even when they had thus grown their size at the bottom was minute.

Outside the load points (i. e., in the outer thirds of the beam length), diagonal cracks appeared, frequently forming from the top of a vertical crack already visible and extending diagonally upward and downward at the same time. In No. 70 the first diagonal crack was visible at an applied load of 468,000 lbs. and in No. 72 cracks became distinctly diagonal at 447,000 lbs. The diagonal cracks developed with the addition of load, but the form of this development was not the same in No. 70 and in No. 72. In No. 70 the slab without stirrups and having the bars bent up abruptly near the ends, one main diagonal crack formed outside each load point. making an angle of about 35 degs. with the horizontal While a few others became visible, these main cracks enlarged and the final failure of the slab was along one of them. In No. 72 (whitewashed surfaces), several marked diagonal cracks had extended for some distance at the load of 480,000 lbs. Some of these finally extended to within 12 ins. of the top face of the slab, but they remained small and fine and were well distributed over the beam.

The manner of failure of No. 70 and No. 72 was quite different. Although it is evident from calculations that the steel of the reinforcing bars in No. 70 had nearly reached the yield point, there was no evidence of this in the appearance and action of the beam at the time of failure. At a load of 593,000 lbs. the main diagonal crack outside of one load point was seen to be extending rapidly and at 734,000 lbs. it was opening wide. It was evident for some time that the beam was on the verge of total failure. Finally it failed suddenly by diagonal tension (so-called shear failure), at an applied load of 801,000 lbs., the diagonal crack having suddenly extended to the top of the slab and opened wide. At the same time the horizontal crack, which had formed along the reinforcing bar (by the action of vertical tension), lengthened and the bar pulled away from the concrete above.

The characteristic of the test was the formation of main diagonal cracks at either end and the final sudden failure of the beam by diagonal tension. In No. 72 the presence of the stirrups and the changed position of the reinforcing bars at the ends were sufficient to resist the diagonal tension developed. Although the diagonal cracks were numerous and although some of them finally extended to within 12 ins. of the top face of the slab, they remained small and fine and were well distributed. They lacked the growth and concentration which are apparent in failures by diagonal tension in beams without metallic web reinforcement. The tension cracks in the middle third of the beam extended upward as the load was increased and at 811,000 lbs. nine of these were visible to within 12 ins. of the top of the slab. At this load the tension cracks were opening wide, indicating that the yield point of the reinforcing steel had been passed.

The maximum load applied was 840,000 lbs., but above 800,000 lbs. the deflection increased rapidly. It seems evident that a load of 811,000 lbs. would not have held long, and the maximum load applied held but momentarily. After the maximum load was reached, the load fell off as the deflection was increased. The charasteristic of the test of No. 72 was slow failure by tension of the steel, without sign of compression failure and without sign of impending failure by diagonal tension. The effectiveness of the stirrups and the bending of the bars at the ends is made evident by the test. This is the more important as the diagonal tension failure may give little warning and may develop with repetitions of lower

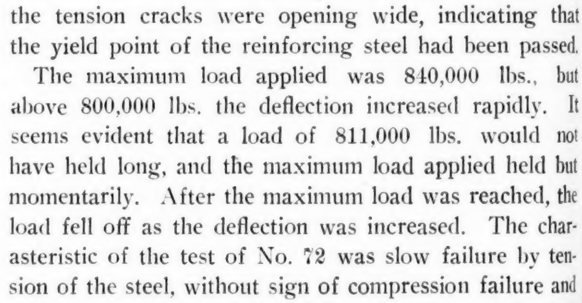


FIG. 5—VIEW SHOWING FAILURE OF NO. 70 BY DIAGONAL TENSION

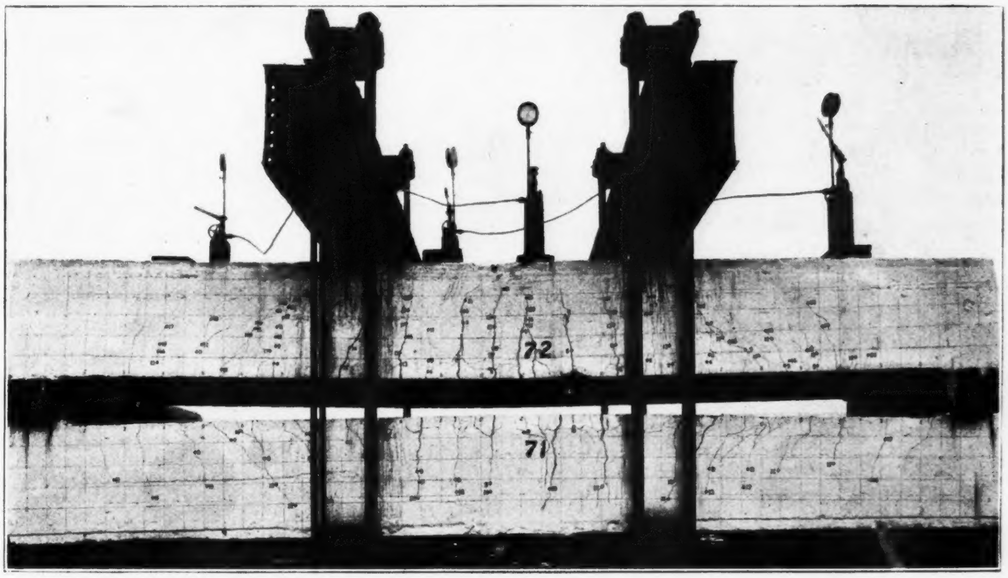


FIG. 6—VIEW SHOWING TENSION CRACKS AT MAXIMUM LOAD.

loads. It may be noted that on the next day the test was continued until there was a deflection in No. 72 of 3½ ins., and the load applied was nearly 800,000 lbs. Upon release of load there was a recovery of 1 in. in the deflection. At this time the stretch of the steel and the consequent concentration of the compressive stress were so much that there was considerable crushing of the concrete. Slab No. 71, which was used as the lower beam in both tests, seems not to have suffered from the first test, the cracks closing up upon release of load. In the second test the tension cracks opened up and at the maximum load there was evidence of the steel being stretched beyond the yield point. It should be noted that on account of its inverted position and the location of the supports the bending moment developed in the lower beam was somewhat smaller than that in the upper beam. There was no sign of impending failure by diagonal tension.

The proportionate depth of the neutral axis for the amount of reinforcement here used, based upon ordinary assumptions, would be in the neighborhood of 0.43 to 0.47. Calculations from the observed deformations give a position which seems abnormally high, averaging during the later stages of the test about 0.34 of the distance from the top of the slab to the center of the reinforcing bars. An examination of the original data suggests that there was slip in the top extensometers and that the neutral axis must have been lower than shown by these results. The vertical position of the line for top fiber compression given in the diagram between loads of 220,000 lbs. and 320,000 lbs. (showing little increase in the compression) shows where the trouble lies. It should be noted that with such slip of the upper extensometer the real compression deformation would be greater than that given in the diagram and that the real tensile deformation would be somewhat less.

The vertical shearing stress in the concrete at the breaking load of No. 70, calculated by the formula

$$v = \frac{V}{b\,d'}$$

(Where V is the total vertical shear at the point where the crack begins, including the shear due to weight of slab, and b is the width of the slab, and d' is the distance from the center of the reinforcing bars to the center of gravity of the compression area of the concrete, called here 0.87 of the depth to center of reinforcing bars), is 209 lbs. per sq. in. The vertical shearing stress so calculated may be used as a means of comparison of the resistance to diagonal tension. 209 lbs. per sq. in. is a high value for a beam without stirrups and having bars bent up abruptly at the end, and shows a good quality of concrete.

The value of v for the applied load of 468,000 lbs., where the first diagonal crack was noted, is 125 lbs. per sq. in., and for the applied load of 593,000 lbs., where the main diagonal crack was seen to be lengthening rapidly and becoming more marked, was 156 lbs. per sq. in. In No. 72 the value of the vertical shearing stress, v, at the maximum load applied is 220 lbs. per sq. in. As there was no sign of impending failure and as the diagonal cracks closed up after the failure of the beam, it is seen that the provision against failure by diagonal tension was very satisfactory. At the load of 447,000 lbs.—giving a vertical shearing stress of 120 lbs. per sq. in.—there was a marked increase in the reading of the vertical extensometer at one end of the beam and an evident development of the diagonal crack. A similar development was noted with the extensometer at the other end at a load of 514,000 lbs. Above these loads the readings of the vertical extensometers increased rapidly.

The tension in the reinforcing bars at the middle of No. 70, calculated by the usual methods, and including the effect of the weight of the beam, was 51,700 lbs.

TABLE 1.
RESULTS OF TEST OF NO. 72.

Ref. No.	Applied Load, Pounds.	Average Deflection, Inches.	Stress in Steel* 1 lb. per sq. in. From Deformation.	From Bending Moment.
0	25,000	0.00		1,500
1	45,000			2,700
2	67,000	0.01	300	4,100
3	103,000	0.02	1,200	6,300
4	131,000	0.03	2,100	8,000
5	159,000	0.05	3,600	9,700
6	189,000	0.10	6,000	11,500
7	220,000	0.11	7,500	13,400
8	253,000	0.13	10,500	15,300
9	285,000	0.17	14,700	17,400
10	317,000	0.18	17,700	19,300
11	350,000	0.24	20,100	21,400
12	382,000	0.28	23,100	23,300
13	414,000	0.31	25,800	25,300
14	447,000	0.36	27,900	27,300
15	480,000	0.40	29,400	29,300
16	514,000	0.43	31,800	31,400
17	578,000	0.52	36,900	35,300
18	643,000	0.61	42,000	39,300
19	704,000	0.70	47,700	42,900
20	780,000	0.88	61,200	47,700
21	811,000	1.32	108,000	49,600
22	840,000	1.60		

*Add 2,800 lb. per sq. in. for stress due to weight of slab.

REMARKS.

Ref. No. 0—This load of 25,000 lb. is assumed as the weight of testing apparatus and men and the initial tension of rods. After jacks were in operation all but 9,000 lbs. was indicated by readings of jacks. The "Average Extensometer Readings" are for a gauge distance of 50 inches.

Ref. No. 5—Short tension crack just inside south load point.

Ref. No. 6—Numerous tension cracks.

Ref. No. 7—Vertical cracks just outside load points.

Ref. No. 10—More cracks outside of load points.

Ref. No. 21—Tension cracks opening wide.

Ref. No. 22—Maximum load. Tension failure.

per sq. in. at the maximum applied load of 801 000 lbs. As the tension cracks in the concrete closed up after the failure of the beam it would seem that the steel had not been stretched beyond its yield point. In No. 72 the calculated tension in the reinforcing bars, including the effect of the weight of the slab, was 54,000 lbs. per sq. in. for the maximum applied load of 840,000 lbs. For the applied load of 811,000 lbs., where the yield point evidently had been passed, the calculated tension is 52,-300 lbs. per sq. in. These values check up with the yield point of the material within the limits of variation of such material.

The compression in the upper fiber calculated by the ordinary methods runs up to a high figure, as is usual in tests of beams having a considerable amount of reinforcement. Assuming the neutral axis to be at 0.43 of the depth to the reinforcing bars, and using the ordinary straight-line formula, the compressive stress in No. 72 at the maximum load was 3,190 lbs. per sq. in. Using the parabolic formula and considering that the compressive deformation is one-half of the ultimate compressive deformation of concrete, the calculated stress is 2,870 lbs. per sq. in. Even at this high calculated stress there was no sign of compression failure until after the steel had stretched beyond its yield point. Comparing the deformation developed with that of other tests it seems probable that the beam would have taken at least one-third more compressive stress before failure in compression at first loading. Of course, repetitive loading at any such high load might soon have injured the beam.

The tests showed that the concrete was of excellent quality and that the slabs acted similarly to high-grade test beams made and tested in laboratories. The uniformity and regularity of these large beams are shown in various ways in the tests. As these slabs may be presumed to be fairly representative of the slabs fabricated for the work, the tests will add confidence in the quality and soundness of the reinforced concrete used in this work. The action of the concrete in compression under the high stresses developed was quite satisfactory. The tests show the effectiveness of stirrups and of the method used in bending up bars at the end in resisting diagonal tension. As diagonal tension weakness is particularly undesirable, because of possibility of sudden failure and of injury with repeated application of the load and because of the difficulty of detecting incipient failures when the sides of the beam are not available for inspection, ample safety against these stresses is important. Failures by tension of the steel and by compression of the concrete give warnings through abnormal deflections and in other ways and are less likely to lead to serious results.

Completion of a New Branch Line

The Pennsylvania Railroad Company has just completed and placed in service a new branch line starting one mile south of Ellsworth, Pa., and extending a distance of nearly eight miles to Marianna, a town recently established by the Pittsburg-Buffalo Company, West Zollarsville, Washington county, Pa.

The construction of this branch was commenced in the latter part of 1906, and among the numerous obstacles to be overcome was the crossing of the Scenery Hill Ridge, upon which is located the famous National road, extending from Cumberland, Md., to Wheeling, W. Va., over which Henry Clay, Daniel Webster and others were accustomed to travel in stage coaches before railroads were established. Many of the old stone taverns of former days are still in existence alongside of this National road.

It was the original intention of the railroad company's engineers to construct a tunnel under the National road at Scenery Hill but as it was necessary to have siding facilities on this summit, they changed their plans, and made a cut of about 90 ft. in depth through the ridge for a distance of nearly half a mile in order to admit of reasonable operating grades.

Owing to their importance these extensive improvements have been carried on without a halt throughout the present financial depression.

*The Telephone in Railroad Service**

By W. W. Ryder.†

THE electric interurban roads early recognized the desirability of the telephone and they have extended their use of it until it is now recognized by them as the standard method of operation.

The steam roads, however, with their ultra-conservatism, were loath to part with the long established telegraph, and it is only recently that the use of the telephone for this purpose has been attempted on a sufficiently large scale to secure a fair demonstration of its possibilities. The immediate incentive for these experiments was the near approach of the date for the enforcement of the federal nine-hour law, coupled with the well defined shortage of telegraph operators that had existed for two or three years.

The first experiment on the Burlington of handling trains exclusively by telephone was begun on the 11th of last December, on the main line between Aurora and Mendota, 46 miles, and 11 offices. The result was so satisfactory that the construction of another circuit from Aurora to Galesburg, 125 miles, with 16 offices, was immediately authorized to handle the despatching between Mendota and Galesburg. This circuit was completed Jan. 24 and has been in use regularly since that date.

On March 1 the third telephone circuit was completed. This extends from Clyde, the end of the Chicago terminals, to Aurora, a distance of 28 miles, with 15 offices. These three circuits are all on double track.

On March 19 the first installation on single track was completed between Aurora and Savanna, a distance of 106 miles, with 23 offices.

Up to this time, while many who personally investigated the matter were willing to concede its efficiency as applied to double-track operation, they were very skeptical as to what would be the result on single track. In this district, they overlooked the fact that in our method of double-track operation, the irregularity of reverse movements in reality made the requirements on such lines more exacting than on single track where opposing movements were perforce the regular method of operation. The results of this last installation were even more marked than on double track, and I am convinced that the handling of trains by telephone is not only much more satisfactory, but is really safer as well, and this opinion is shared by all who have personally looked into the matter.

We use two 210-lb. copper wires and have made the installation as complete and perfect as we know how. With the present market price of copper, the telephone circuit costs approximately $100 a mile and the station equipment about $50 per station. This is more expensive than the telegraph circuit, and the maintenance will be a little more difficult and the cost a little higher, but the results have proven so absolutely satisfactory we feel the additional expense is fully warranted.

Our arrangement makes the circuit entirely self-contained, that is, the signaling and talking is all done on the same pair of wires. The signaling is done by semi-automatic selectors that enable the despatcher merely by the depression of a couple of buttons in connection with a series of synchronous clocks to ring at will vibrating bells in one or more offices on the circuit. This is a much less laborious method of calling, and we also find a very great saving in time, the operators responding very much more quickly than is the practice with the telegraph. In the local offices we put a 4-in. vibrating bell, one large enough to be heard at a considerable distance, and when this bell lets go without any preliminary warning, the one thought of the operator is to shut it off and so he immediately answers the call. More often than otherwise the operators to avoid the annoyance of the signal bell forestall the despatcher's call and report trains as soon as they pass.

In handling orders, the same general methods are observed as with the telegraph, any figures or names of stations occuring in the order being spelled out letter by letter, both in the giving of the order and all of the repetitions, and the name of the conductor on a "31" order is spelled out as well.

The use of the telephone is so quick in every way, and so much more flexible, the despatcher is enabled to get far more detailed information of just exactly what each train is doing, even, when occasion requires, talking directly with the conductor or engineer personally, and is thus brought just so much nearer the actual details of train movement. Only a personal investigation of the scheme can show how valuable is this information.

There has also been a marked improvement in the work of the men on these telephone circuits due to the fact that the conversations between the despatcher and the operators or other employes are of a much more personal character than obtains with the telegraph, resulting in much closer co-operation.

It is even possible to save considerable time in the actual putting out of orders. The despatcher copies the order in his order book as he talks it off, thus gaging, or rather reducing, his speed of conversation to his ability to write it down, as well as the ability of the operators to do so. Then when the operators repeat the order they talk it off as fast as they can or much faster than is possible by telegraph.

The change in method in every case was made without a hitch and without any opposition worth mentioning. I had an idea that while possibly the despatchers themselves might not openly oppose the change, their support might be of a passive character, but in this I was agreeably disappointed. The first circuit had not been in operation a week before a little spirit of jealousy was evidenced, directed against the despatchers on the telephone circuit, it being so clearly evident they had the "snap" of the office. Soon all the despatchers in Aurora office were desirous that we give them the same

*Read before the convention of the Association of Railway Telegraph Superintendents, at Montreal, Que.

†Superintendent of Telegraph, Chicago, Burlington & Quincy.

facilities, and now that all have been taken care of, there is not one out of the twelve that would willingly go back to the old method.

It is far easier to train telephone operators than to secure telegraphers. There is hardly a town anywhere on the line in which there are not young fellows, who by reason of their frequently being around the depot, are more or less familiar with the railroad game, and who with a very little training would be perfectly competent to sit in as telephone operators. There is much to be gained by making use of men in in their own home towns, or who have grown up along the line. Our telegraph service was at its best when this condition existed to a considerable extent, and discipline has lessened in proportion as we have been compelled to import telegraph talent.

This increased use of the telephone has also opened an avenue whereby we can offer better employment to those unfortunately injured in our service, few of whom in the past have been able to learn telegraphy.

Another item worthy of consideration is the broadened field from which we can make despatchers. In the past, the first requisite for a despatcher was an ability to telegraph, and with the character and ability of telegraphers in general dropping as fast as it has during the past two or three years, we certainly can but expect difficulty in the future in getting satisfactory talent, even if this difficulty has not been greatly evidenced in the past. I maintain that a good, bright young freight conductor, who has been actually carrying out the train orders, would make a better despatcher himself and be better able to assist in getting other trains over the road than is the telegraph despatcher, who, in spite of his occasional trips on freight trains, is a theorist after all.

The establishment of telephone circuits enables us to close unimportant offices wholly or a portion of the time, as a telephone instrument can be placed where the train conductors can readily get in touch with the despatcher.

Another important feature in the use of the telephone is the fact that it works even better in bad weather than in good—just the reverse of the telegraph—and if there is ever a time when good service is needed, it is when the weather is wet and foggy. There is no exasperating interference with the despatcher's efforts by reason of the relay in some way office being out of adjustment and the inattentive operator making no effort to see whether this is the case or not. The telephone is always in proper adjustment and because of the lowered static capacity of the circuits, works as if charmed.

With the telephone it is possible to arrange apparatus, for instance in the superintendent's office, so that he can at any time listen to the actual work of the despatchers and operators and thus check up any tendency to slackness. This has not always been possible in the past, as not all superintendents were telegraphers.

The improvement in the handling of train despatching by telephone has been so clearly demonstrated, we have decided to attempt to handle other messages in like manner and in a short time all business for the way offices on certain portions of our line (both main and branches) will be handled by telephone, this to include Western Union business as well. At junction points where branch telegraph lines are to be worked and at certain wire test offices, it may be necessary to maintain telegraph service, but at all other points all classes of business will be handled by telephone.

The field for substituting the telephone for the telegraph daily opens up before us almost faster than we can comprehend it, and the results we are obtaining from our experiments are a constant but very agreeable surprise. For instance, only about a month ago it seemed next to impossible to get satisfactory telephone service on single-wire branch lines without completing the metallic circuit and this the volume of business did not warrant. But within the last few days we have made successful substitution on two branch lines, one 18 miles long with three offices, and the other 49 miles long with ten offices. These branch wires have been so arranged that while not connected permanently with the main line, they can be connected at the will of the despatcher or the way office operator, the signaling on the branch being done by means of ordinary bridged bells.

The unqualified success of our experiments with the telephone as a substitute for the telegraph and the rapidity with which other roads are extending the work, convinces me that the next few months will make a great change in method of handling trains all over the country, one that will greatly benefit the service.

Electrifying German Railroads.

The railroad ministry will permit the first great attempts to be made with electrical power in connection with the centrals now existing in the administrative district of Magdeburg. In the first place the short sections Gusten-Stassfurt and Gusten-Bernburg-Kothen will be arranged for electrical operation. Later, in further execution of plans, there will be a change of power on the line Magdeburg-Bitterfeld-Leipzig, and afterwards on the line Halle-Leipzig. Upon these, in themselves complete lines of road, electrical power will wholly supplant steam.

The line Leipzig-Halle has been chosen for a special reason. By the electrical operation between these two points there will be a greater increase in the speed and frequency of the trains dispatched, so that in this way Leipzig will be brought into closer connection with the western main lines. The two lines are under the direct management of Halle, which has been instructed from the ministry at Berlin to make a detailed inquiry how far electrical power can be economically used in comparison with the present method of operation. It is said that the preliminary work for this statistical inquiry has already been done by the ministry, so that the administration at Halle has only to verify the results already obtained.

The most favorable factor for the economical determination of the question are the bituminous deposits

(Braunkohlen) between Halle and Leipzig. This kind of coal is not considered a suitable fuel for locomotives. One electrical central will suffice for the operation of both lines, and this will be built in the midst of the coal strata. Some years ago the favorable location of these strata suggested the electrifying of the railroad between Koln and Trier, but this was abandoned.

It is said the passenger traffic will be handled in the same manner as upon the road Berlin-Lichterfelde-Ost, namely, with small trains and quick service. The express and freight trains will be dispatched with electrical locomotives. The length of the two lines together amounts to 102½ miles, the line Leipzig-Magdeburg being about 80 miles and the line Leipzig-Halle 22½ miles. For the current, which will be conducted on thin wires, 10,000 volts will be required. It is calculated that the change in the system of operation will take two years.—Consular Report.

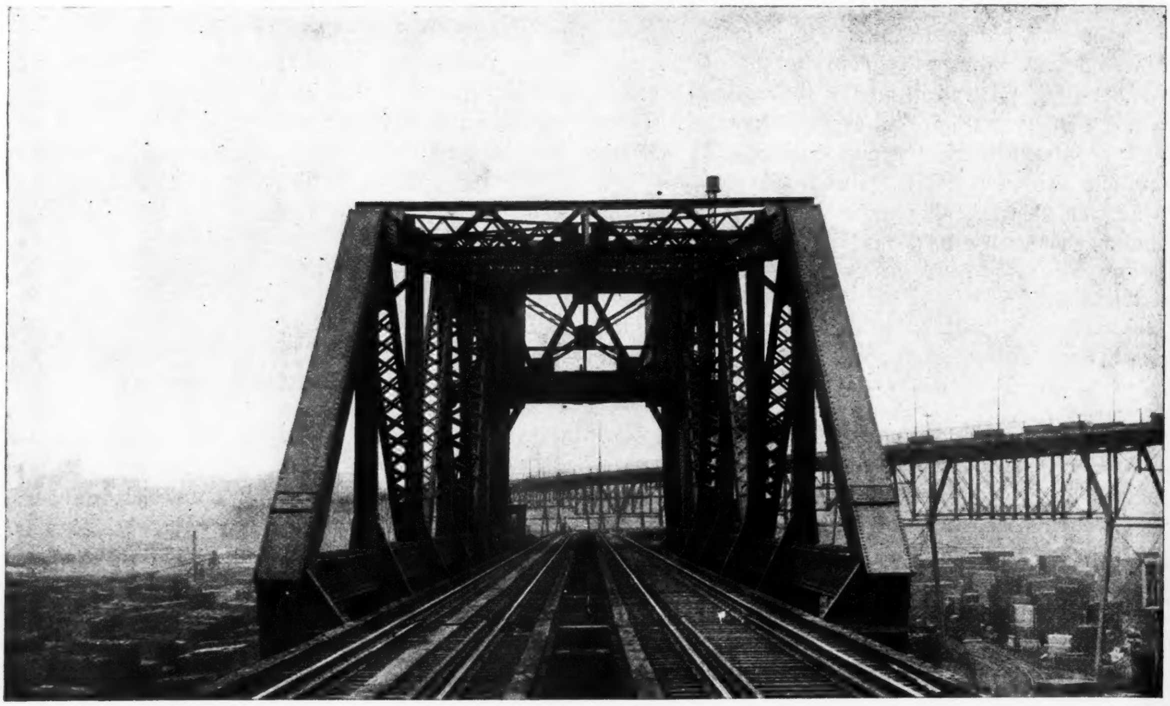
Nickle Plate Improvements at Cleveland

AMONG the many improvements made by the New York, Chicago & St. Louis Railway Company in carrying out a policy of betterment in way and structures is the reconstruction of the long viaduct and draw carrying their tracks over the valley and channel of the Cuyahoga river at Cleveland, completed and placed in service early this year. This viaduct has a total length of nearly 3,000 ft. at a height of about 60 ft. and consists of deck plate girder spans supported on steel towers, varied by two through truss spans, three deck trusses, one half-through plate girder span and a Scherzer rolling lift span across the river channel, the base of rail on the draw span being 70 ft. above the water.

The demand for better internal harbor facilities at Cleveland and the improvement in the channel of the Cuyahoga river by the federal and municipal authorities to provide for the increasing navigation necessitated the reconstruction of the viaduct, the removal of the old center pier swing bridge, a view of which is shown in Fig. 1. and replacement of the swing bridge with a modern type of bascule bridge. The two adjacent Scherzer rolling lift bridges in use by the Newburgh & South Shore and the Baltimore & Ohio railroads across the upper part of the river had recently been placed in service at the time the carrying of the viaduct across the river was under consideration and the success of these bridges led to the adoption of a duplicate structure for the new viaduct.

All of the new work was erected while maintaining railroad traffic, the bascule span being erected in the open position so as to cause no interference to either railroad traffic or navigation. Arrangements were made

VIEW SHOWING SHERZER ROLLING LIFT BRIDGE IN A PARTLY OPEN POSITION.

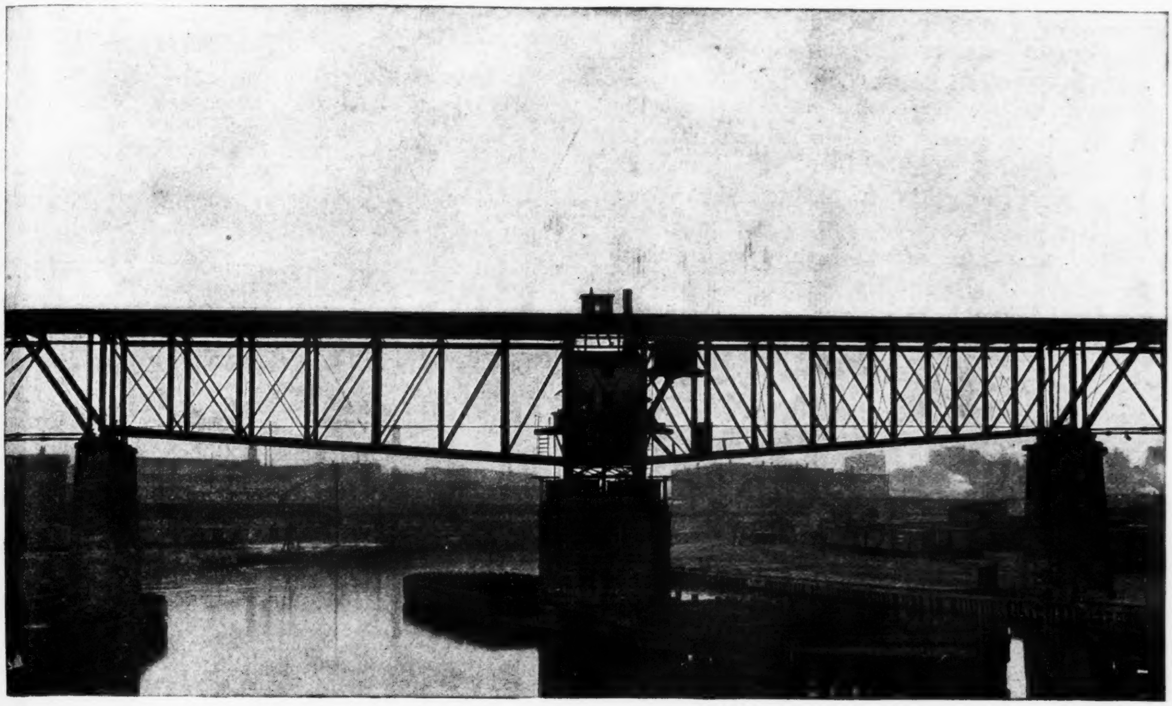


VIEW SHOWING LINE OF TRACKS WITH SHERZER R LLING LIFT BRIDGE IN CLOSED POSITION.

for operating the old swing bridge during the reconstruction by cutting off several panel lengths, counterweighting the shortened arm and resting it upon temporary pile supports in front of the tower supporting the bascule span. In this way one of the old channels was left entirely free for navigation, as may be seen from the plan and elevation drawings, Fig. 2, which also show the relative size and positions of the old and new draws.

The Scherzer rolling lift bridge is a double track single leaf through bridge having a length of span center to center of bearings of 160 ft. and a width of 29 ft. 6 ins center to center of trusses. The clear channel for nav-

VIEW SHOWING SHERZER ROLLING LIFT BRIDGE IN CLOSED POSITION.



OLD CENTER PIER SWING BRIDGE FOR THE N. Y., C. & ST. L. RY. AT CLEVELAND.

igation provided by the new bridge is 120 ft. measured at right angles to the channel, which makes an angle of 62 degs. 30 mins. 30 secs. with the center line of the bridge. The track girders upon which the bascule span rolls are supported by a steel tower 48 ft. 9 ins. high from masonry piers to the tops of the tower posts, the track girders having a depth of 10 ft.

The tower posts are vertical front and rear with a

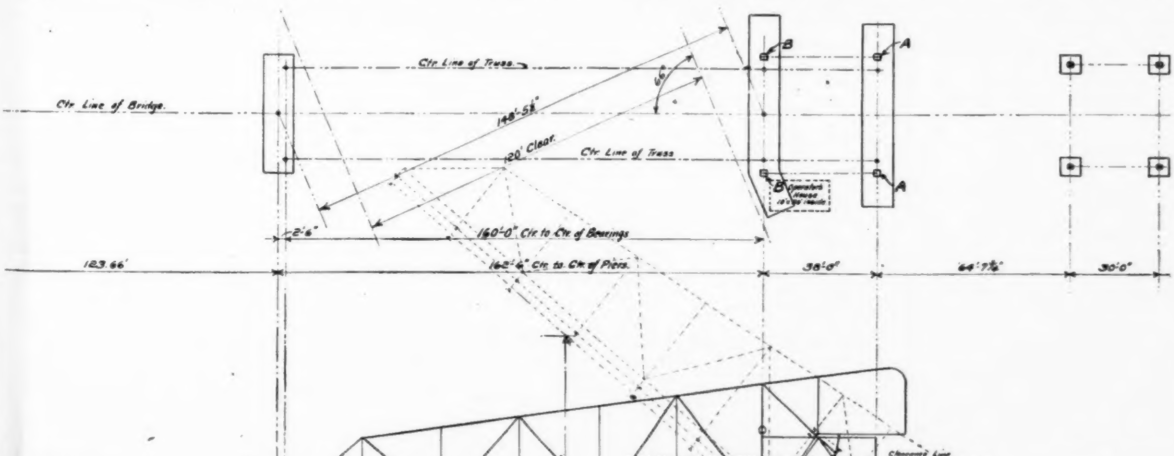


DIAGRAM SHOWING METHOD OF ERECTION AND SHOWING RELATIVE SIZE OF NEW AND OLD DRAW SPANS.

side batter of 1 in 12. The front end of the bascule span when closed is carried by the deck truss fixed approach span, the piers supporting this span being of concrete to the full height of the under side of the trusses which have a depth of 20 ft. The bridge is operated by two direct current electric motors of 50 h. p. each, the motors being placed on the moving leaf and operating the bridge by driving a shaft attached to pinions engaging in racks placed on fixed supports outside of each truss. The motors are controlled from controllers placed in the operator's house and are equipped with solenoid brakes directly attached to the motors. The bridge is also controlled by an auxiliary mechanical band brake operated by foot power from the operator's house.

The operator's house also contains a small gasoline engine as an auxiliary to operate the bridge in place of hand power should there be any trouble from defective current or electrical equipment. A mechanical equipment is also provided and placed in the operator's house for operating the railroad signals at each end of the bridge, this equipment being interlocked with the end latch and the electric controller so that the bridge can not be operated until all of these signals have been set at "danger." An end latch operated from the operator's house is provided to maintain the bridge in the closed position and is of sufficient strength to resist the full power of the main operating plant. Rail locks are also provided operated by a small independent electric motor placed in the operator's house.

Figures 3, 4 and 5 show views of the new bridge as completed, in the closed position, in the partly opened position and along the line of tracks when closed.

The entire work was designed under the general specifications of the New York, Chicago & St. Louis Railroad Company for steel bridges, 1904, and was executed under the charge of the engineering department of the railroad company, Mr. E. E. Hart, chief engineer, and Mr. A. J. Himes, assistant chief engineer. The Scherzer Rolling Lift Bridge Company, Chicago, designed the superstructure, operating machinery and electric equipment of the draw span and maintained a general consulting engineering supervision during its construction and erection. The superstructure was fabricated by the King Bridge Company, Cleveland, and erected by the Pittsburg Construction Company.

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*Some Features of the Present Steel Rail Situation**

By Dr. C. B. Dudley

It is surely not too much to say that in the past 25 years the changes in the conditions in which the rail is involved have in three respects been most noteworthy: First, the average speed of trains has been largely increased; second, the average wheel loads of cars have been increased 75 per cent and of locomotives over 100 per cent; and third, on some of the larger and more important railroads the volume of traffic has increased at least 300 per cent, and perhaps more.

Let us examine this matter a little and ask ourselves the question plainly, what have the railroads done to meet the changed conditions? First and foremost, the weight of the rail per yard has been increased. As a matter of record it may not be amiss to mention the successive steps of this increase on one large railroad. Within my own memory and study of this subject, the following weights of rail have been employed: 56 lbs. per yard 60, 67, 70, 75, 85 and 100. The increase is quite noticeable, the latest form being nearly double the weight of that first speed. The battle of the sections, or the form in which the increase of weight has been disposed, will be referred to later on.

But it may be said, "It is granted that the weight of rail has been increased, but what evidence is there that the increase has been sufficient?" "Is not a rail weighing 110, 120 or even 130 lbs. per yard essential to meet the strains produced by the changed conditions above referred to?" Upon this point it is possible to say that most careful studies have been made, using the best obtainable data, and making allowances for what is more or less unknown and uncertain, and that the studies indicate that the weight of rail to carry the increased wheel loads has been increased more rapidly than the wheel loads, and that the actual strain in the heavier wheel loads is no greater than was the case in the lighter rails under the lighter wheel loads formerly employed. It may be added that if 12,500 lbs. per sq. in. is assumed as a safe working stress for such steel as rails are made of, the present 85 and 100-lb. rails show stress well within this limit, even under a static wheel load of 30,000 lbs., with a dynamic augment of 60 per cent of the static load. If these studies can be trusted, therefore, it would seem that so far as weight of rail is concerned the railroads have done all that could reasonably be required to meet the changed conditions with which we are dealing.

But again it may fairly be asked, we think, whether increase in weight of rail is all that is required. No principle of structural construction is better established apparently than that the support which material under strain receives is an essential element in its successful behavior. The rail alone cannot carry the load. It must be properly supported and, perhaps, mind you, I say "perhaps," failure to properly support the rail may account for some of the rail failures, of which we have

*Extracts from the opening address of the president at the eleventh annual meeting of the American Society for Testing Materials.

heard so much during the past few years. Good railroad track involves a properly drained subgrade, ballast, ties and rail fastenings, splice bars and other joint material, and the proper maintenance of these, as well as rails. In other words, the rails are only one of the elements in the problem; I grant you, the most important one, but still not the only one. It would be manifestly unfair to blame the rail for failures which may be clearly due to defective support or fastenings.

During the past year or two, in discussions and committee meetings over rail specifications, the desire on the part of some railroad engineers has occasionally cropped out to have a rail of minimum weight per yard, and yet so good that even though the track might not always in every detail be kept up to standard, there would still be no failures. According to their view, if the rails were what they should be, inferior track maintenance would be a very small matter. And singularly enough, it seemed to be a little difficult for these engineers to see that this unloading of the whole problem upon the steel rail manufacturers, was not entirely legitimate and praiseworthy. We hope to pay our respects to the steel rail manufacturers a little later, but we are compelled to say that this view of the case does not commend itself to us, and that we do not think responsibility can be so easily shifted to other shoulders. No one can be more desirous of good rails than we are, but failures in track maintenance cannot, we think, fairly be put upon the rail. On the other hand, we do think there is a legitimate question connected with this phase of our subject. This is, the requisite safety being always maintained, where does true economy lie in this contest between the rail and the track maintenance? There are three possibilities.

(1) Would better rails with the same weights per yard as are now in use, even though obtained at increased cost, result in such diminution of track expenses that economy would result?

(2) Would the same so-called inferior grades of steel that is now being furnished, with increased weights per yard, it being conceded that increased weights per yard are not essential from the standpoint of strains, result in such diminution of track expenses that economy would follow after paying for the increased weights? and

(3) Would better steel and increased weights per yard, at even still greater cost, be followed by such saving in other track expenses that it would be true economy to obtain such rails?

We do not believe the data exists at the present time that would enable a satisfactory answer to be given to any one of these three questions. And yet they seem to us to open up an extremely important field. It costs a certain amount each year to maintain a mile of track, including rail renewals, and we have never seen any failures that show that the distribution of the expense to each item is such that the sum total is a minimum. Perhaps better rails, perhaps heavier rails, perhaps the two combined, even at greater cost for rails, would bring about this desired result.

Is the steel that goes into rails today better or worse than that made 15 or 20 years ago? It is well known that there is a general belief among railroad engineers that the steel in the rails today is nothing like as good as it was 20 or 25 years ago. We are not quite able to follow these critics to the extent that they want to go on this point. Our judgment is that in two respects there is reason to think the steel in Bessemer rails is inferior to that made 25 years ago:

(1) The larger ingots of the present day necessarily lead to increased segregation, and in so far as segregation is a serious element in the quality of steel, there is little room for doubt that the steel in the rails of today is inferior to that made some years ago. We think it fair to say that there is need for further study as to how far segregation, apart from internal physical defects with which it is so often associated, is a menace. We cannot help wishing that it was not in the rail to anything like as serious an extent as many analyses show it to be, but, at the same time, if the ingot was thoroughly sound throughout, we should like to study segregation farther before feeling willing to say the final word.

(2) In so far as the more rapid working of the Bessemer process, which has seemed to characterize its full commercial development during the past 20 years or more, has led to incomplete action between the final additions and the blown metal, and to higher finishing temperatures in the finished rail, the metal must be inferior. The making of steel is a chemical process, and every chemist knows that all chemical reactions require time, and it is to be feared that Bessemer metal is, many times, cast in the ingot mould before the reactions are complete. The effect of this is certainly bad. Sound ingots cannot be obtained in this way, and if the ingot is unsound, good rails cannot be made. Again, we are quite well aware that high finishing temperatures are blamed on the rail section. Thin flanges, by getting cool too soon, seem to make it impossible to roll the head at the proper finishing temperature, and it is to be confessed that in so far as the section is responsible for too high finishing temperature, the steel maker cannot fairly be blamed. But for all other causes leading to too high finishing temperatures, it is difficult to see how the responsibility is to be shifted. Notwithstanding these, as we regard them, just criticisms of the later made Bessemer steel, it is undoubted that a large percentage of the output of rails of the last 20 years has been approximately as good as that previously made. We are inclined to think that those who so vigorously denounce the later made steel, forget the enormously increased traffic which these rails have carried. The lack of reliable figures showing comparative tonnage of the earlier and later made steel, is a very serious handicap in reaching a satisfactory conclusion in this matter.

Let us turn now to two or three other features of our subject; and first, as to the sections. It has already

been hinted that the section has been blamed for some of the difficulties encountered in making good rails. The makers have urged, and we think with good show of reason, that the distribution of metal between the head, web and foot of the rail, in many of the sections, was such that it was practically impossible to finish the heads at the proper temperature. And since the sections were specified by the railroad engineers, the rail makers have felt, and we think justly so, that in so far as the section was an element in good rails, they could not be held responsible for poor rails. This criticism was felt to be so valid that within the past two years two independent organizations have taken up the question of section de novo. One large railroad, through a committee of its own officers, reinforced by practical rail manufacturers, and the American Railway Association, through one of its own committees, assisted also by a number of practical rail makers, have both, but independently, devoted much study to the section. The results of their deliberations have culminated in three types of sections.

The question of the discard has occasioned many words during the discussions of the past two years, and we had almost said "bitter" words. There is material enough in this feature of our subject for a long paper. I fancy many of us had more positive ideas on discard three or four years ago than we have at the present moment. The more the subject is studied the more difficult it becomes, seemingly, to express a final opinion that we are willing to stand by. If every ingot solidified in the typical way, and was like every other ingot, the question of discard would be easy. But it would almost seem as though every heat of steel was a law unto itself, and was different from every other heat of steel, and nearly the same might be said of every ingot. When we come to consider the conditions, there seems to be much reason why this should be so. The differences in temperature at the time of casting, the more or less incompleteness of the chemical reactions when the metal leaves the ladle, the differences in chemical composition of the different heats, the rate of pouring, the differences in the condition of the moulds, the differences in rate of cooling dependent on surrounding conditions, the differences in practice at the different works, especially in the matter of covering and artificially cooling the top of the ingot, the length of time that elapses before the ingots are shipped, and the more or less fluid condition of the metal on the inside of the ingot when it reaches the first pass, to say nothing of accidents or mishaps that may occur in handling the semi-fluid ingots, all have an influence on the location of that part of the ingot which is supposed to contain the poorest of the metal, and which it is the object of the discard to prevent from getting into the rails.

During the past few years much light has been thrown on the subject, and the truth compels us to say, that a situation has been found that in some respects would be ludicrous, if it was not so near the tragic. Let us see what the conditions have been:

(1) The manufacturers have in many cases at least selected the rail end as sample for test. The specifications being silent on the selection of the test piece, they naturally have urged that there was nothing to prevent their doing this, and they naturally again have, so far as information can be obtained, chosen the best steel in the ingot for test. It is not claimed that all specifications have been so loosely drawn as to permit such a suicidal practice, but it is certain that some of them have, and that the practice has been in vogue.

(2) The best two in three principle has pervaded many specifications, that is to say, if the first rail end stood the test, the heat was accepted, but if it failed a second was tested. If this likewise failed the heat was condemned. If, on the other hand, it stood test, a third was tested, and the fate of the heat was decided by the majority. It would almost seem as though the specification had been drawn, not with the idea of being sure that only good rails should be accepted, but with the idea of being sure that as many heats as possible should be accepted.

(3) Only one heat in five was tested, that is to say, as we understand the matter, if the rail end stood test and the heat was accepted, that acceptance carried four other heats with it. But, singularly enough, if, on the other hand, the heat was rejected, that rejection only covered the heat from which the test rail end came, and the four preceding or following heats, as the case might be, got another chance for their lives. The unsatisfactoriness of such a method of testing, it seems to us, must be evident to every candid mind that knows anything about the making of steel. As has already been stated, every heat of steel is a law unto itself, and there is no certainty that because one heat or blow is good the preceding or succeeding four are equally good any more than there is a reasonable presumption that if one heat is bad, the preceding or succeeding four are likewise bad. And while it is agreed that when everything is working well successive blows from the Bessemer converter may be similar in many respects, it is not agreed that testing one blow in five gives any reasonable assurance that only good rails are accepted for use in the tracks.

A few words now in regard to some of the details of testing rails, and first in regard to the drop test. It is well known that many testing engineers do not favor the drop test for rails. To our minds, however, it is the only possible available one for the present, and the following considerations seem to us to have weight in confirming this view:

(1) It tests the whole rail in the condition in which it goes into the track, instead of a small fraction of the rail, as is requisite in all cases of prepared test pieces.

(2) It is sufficiently rapid, so that even though every blow is tested there is no fear of delaying the output of the mills, while waiting for test pieces to be prepared, or for slower tests to be made. We have known of a case where, with sufficient force to handle the test sam-

ples, 55 tests have been made in half an hour on a modern drop testing machine.

(3) There seems little doubt but that some of the strains or shocks which the rail actually receives in track are similar to those produced by the drop testing machine. This is, we think, clearly the case with a loose joint and a rapidly moving train. In case the track bolts have become loosened, the end of the rail, when the approaching wheel mounts it, certainly gets a blow similar to that given by the drop testing machine. We have known rails which have given long service in track to be broken in this way, and the fracture showed perfectly clean, sound metal.

(4) Finally, if the specification requires that the deflection be taken, the drop test reveals a good deal in regard to the physical properties of the steel.

Second, in regard to the selection of the test piece. We fancy it goes almost without saying that this should always be made by the inspector. In regard to location of test piece, it is, of course, understood that in shearing the ingot into rail blooms it is necessary to make the bloom from which the test rail end is to be taken a little longer than the others. It is, therefore, essential that the inspector or the specification should designate the bloom from which the test will be taken. Some recent specifications wisely, we think, designate the top bloom of the ingot for this purpose, it being generally understood that the so-called "pipe," if there be any, and the greatest segregation and physical defects will be in this bloom. We may, perhaps, wisely call attention to the fact that if a cover and cooling devices are used on the top of the ingot when it is cast, the poorest steel in the ingot will not be near the top end of the top bloom, but more probably near the bottom end of the top bloom, so that if the inspector takes his test piece from the top end of the rail made from the top bloom, he will be more apt to deceive himself than if he has the test piece cut from the bottom end of the top bloom. We have sometimes thought, when inspecting the practices of casting and cooling ingots in certain works, that it would be better to take the discard between the first and second blooms.

Third, in regard to height of drop. We have always opposed extreme severity of tests. Owing to the defects in the anvil previously referred to, if indeed they have been general, it is apparent that but little information that is of value and that is safe to follow can be obtained from previous tests. Our own view is that something a little more severe than the rail will receive in actual service, enough for a reasonable factor of safety, is all sufficient. The trouble is we do not know how severe the shocks in service are. Some recent tests of rails which had broken short off in track made by the research committee of the Pennsylvania System, seem to indicate that a 15-ft. drop with a 2,000-lb. tup and a 20,000-lb. anvil would have rejected two-thirds of those which failed in service; also that the 15-ft. drop actually broke as many test pieces as the 19-ft. drop, other conditions being the same. These tests should be much amplified before final conclusions can be reached, but as far as they go they seem to indicate that we must look to other causes than defective or poor steel for a portion of the rail breakages, and that extremely severe testing is not necessary.

Summing up and putting in concrete form our views on the present situation, we are inclined to say:

(1) The crying need of the hour is positive, definite information. Upon dozens of points no positive data exist. During the discussions of the past two years or more opinions have been as plentiful as leaves in autumn, but of positive, reliable, statistical information, or figures taken from properly kept records, there has been a dearth that was fairly oppressive. The steel makers have not been as deficient in this respect as the railroad engineers.

(2) The time seems opportune for genuine progress to be made. The railroads, through their organization, which in a sense speaks for them all, the American Railway Association, have taken hold of the matter with vigor, and have developed a large amount of valuable information, and for the first time in my 25 years' study of this subject the steel rail manufacturers have shown a less antagonistic and more conciliatory and co-operative spirit than has usually characterized them.

(3) The specifications proposed by the Pennsylvania Railroad system and by the American Railway Association seem to us to represent genuine progress and to be worthy of most careful study and trial. While they may be said to represent perhaps the best that can be done until more positive knowledge is obtained, he would be a bold man that would claim that they will ultimately be satisfactory or final.

(4) Whether the Bessemer process can be so modified and improved as to enable it to furnish rails that will be entirely satisfactory under the heavier wheel loads and denser traffic of today and the near future, or whether the basic open hearth will soon be the source from which steel for these rails will be furnished, are questions worthy of serious attention. Our own feeling is that if a small fraction of the time and money that has been spent in the past over the commercial development of the Bessemer process shall, in the next few years, be spent in getting sound ingots, free from blow holes, slag and manganese sulphide, if this shall be found to be as serious as it now looks, and in overcoming or minimizing segregation, it will last for many years to come.

(5) The American Society for Testing Materials has a most important duty to perform at this juncture. By stimulating the development of information, by furnishing an arena for the presentation of such papers on the metallurgy of steel as are on its program for this meeting, by arousing interest in testing machines and methods of testing, by furnishing a forum where producer and consumer can meet on common ground and discuss their differences unhampered by commercial considera-

tions or by artificial distinctions of professional ethics, and by keeping their own specifications up to date and utilizing new information as fast as it is obtained, it can so fill the field which it occupies that when the ultimate record is made up its contribution will be by no means among the least.

Timberland Transaction.

What is said to be the largest single sale of timberland in the history of West Virginia has been made by the Baltimore & Ohio Railroad Company to a corporation which will at once begin development. The purchasing company has mills at Ridgeway and at Camden-on-the-Gauley, within reach of the tract. The combined capacity of its mills is 350 000 ft. a day. Two million dollars is the reported price paid for 200,000 acres of hardwood, chiefly virgin forest, containing yellow poplar, cherry, oak, maple, birch, ash and many other valuable woods.

The land lies in a mountainous region drained by northeastern tributaries of the Great Kanawha which empties into the Ohio about 300 miles from Pittsburg. It is one of the largest and most valuable bodies of hardwood timber remaining in the Appalachian region. Many of the mountain ranges which cross the tract are from 3,000 to 4,000 ft. high, and covered to their summits with rich forests.

Convention of Railway Superintendents of Bridges and Buildings.

THE eighteenth annual convention of the Association of Railway Superintendents of Bridges and Buildings will be held Oct. 20, 21, 22, at the Arlington Hotel, Washington, D. C. The president of the association for the year 1907-1908 is R. H. Reid, of the Lake Shore & Michigan Southern and the secretary is S. F. Patterson, of the Boston & Maine.

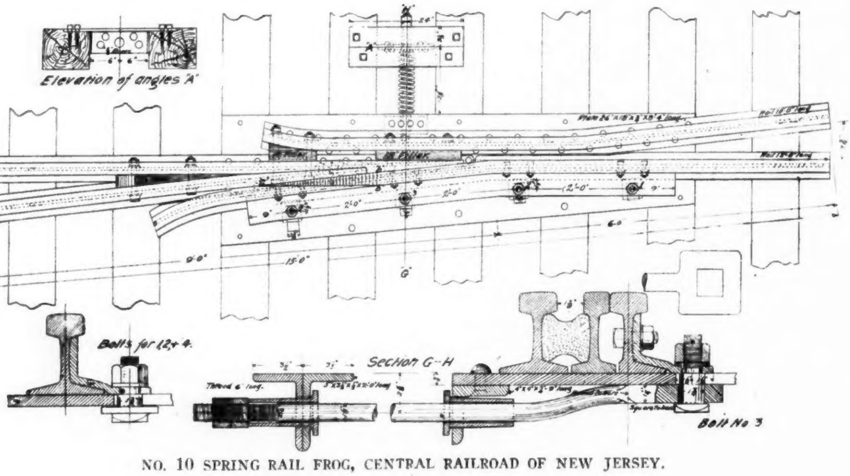
The subjects for report and discussion and the chairman of each committee are as follows:

Waterproofing of Concrete Covered Steel Floors, A. F. Miller, P. L. W. of P., 38 West Van Buren street, Chicago; Modern Equipment and Tools for Erection of Steel Bridges, J. Hunciker, C. & N. W. Ry., Chicago; Protection of Structures Against Effects of High Water by Rip-rap or Otherwise, G. H. Soles, P. & L. E. R. R., Pittsburg, Pa.; Experience in the Use of Gasoline Engines and Kerosene Engines or Combination of Same for Water Supply, Drawbridges, etc., A. S. Markley, C. & E. I. R. R., Danville, Ill.; Modern Dwelling Houses for Section Foremen and Section Men in Outlying Districts, by W. Beahan, L. S. & M. S. Ry., Cleveland, O.; Reinforced Concrete Culverts and Short Span Bridges, A. O. Cunningham, Wabash R. R., St. Louis, Mo.; Methods of Erecting Truss Bridges (a, Maintaining Traffic; b, No Traffic), M. Riney, C. & N. W. Ry., Baraboo, Wis.; Smoke Jacks for Engine Houses, C. A. Lichty, C. & N. W. Ry., Chicago; Pile and Frame Trestle Bridges, H. M. Trippe, C. & N. W. Ry., Chicago; Fire Protection, J. N. Penwell, L. E. & W. R. R., Tipton, Ind.; Fences, Road Crossings and Cattle Guards, J. E. Barrett, L. & H. R. Ry., Warwick, N. Y.; Construction of Coffer Dams, J. H. Markley, T. P. & W. Ry., Peoria, Ill.; Preservation of Timber, F. E. Schall, L. V. R. R., South Bethlehem, Pa.; Coaling Stations and Cinder Pits, F. F. King, C. & N. W. Ry., Sander, Wyo.

Spring Rail Frog.

THE spring rail frog used by the Central Railroad of New Jersey was described briefly in the June issue of RAILWAY ENGINEERING, together with the standard spring rail frogs of other roads. The line drawing, given herewith, shows the construction of the frog.

This particular type of frog is very strong and durable and it has been found very reliable and satisfactory in use. Its reliability and good wearing qualities under the very heavy main line traffic of the Central Railroad of New Jersey justify the use of this frog, which is more expensive than the ordinary type.



NO. 10 SPRING RAIL FROG, CENTRAL RAILROAD OF NEW JERSEY.

Prices on Track Materials, F. O. B. Chicago

Steel rail, 60 lbs. and over.........	$28.00 per gross ton
Steel rail, 25 to 45 lbs.............	28.00 per gross ton
Steel rail, 20 lbs.	29.00 per gross ton
Steel rail, 16 lbs.	30.00 per gross ton
Steel rail, 12 lbs.	31.00 per gross ton
Ties, 6x8x8 oak, 1st grade	74c each
Ties, 6x8x8 oak, 2d grade	67c each

Angle bars, accompanying rail orders, 1908 delivery, 1.50c; car lots, 1.60c.; spikes, 1.80c. to 1.90c., according to delivery; track bolts, 2.20c. to 2.25c., base, square nuts, and 2.35c. to 2.40c., base, hexagon nuts. The store prices on track supplies range from 0.15c. to 0.20c. above mill prices. Switch set per turn out, 60-lb. rail, $85 to $90.

OLD METAL.

Old steel rails, rerolling	$14.70 to $15.25
Old steel rails, less than 3 ft.	13.00 to 13.50
Old iron rails	16.00 to 16.50

SHEET STEEL.

It is quoted for future delivery:

Tank plate, ¼-in. and heavier, wider than 6¼ and up to 100 ins. wide, inclusive, car lots, Chicago, 1.78c.; 3-16 in., 1.88c.; Nos. 7 and 8 gauge, 1.93c.; No. 9, 2.03c. Flange quality, in widths up to 100 ins., 1.88c., base for ¼-in., and heavier, with the same advance for lighter weights; sketch-plates, tank quality, 1.88c., flange quality, 1.98c. Store prices on plates are as follows: Tank plate, ¼-in. and heavier, up to 72 in. wide, 2.00c. to 2.10c.; from 72 to 96 ins. wide, 2.10c. to 2.20c.; 3-16 in. up to 60 in. wide, 2.10c. to 2.25c.; 72 ins. wide, 2.30c. to 2.40c.; No. 8 up to 60 ins. wide, 2.10c. to 2.15c.; flange and head quality, 0.25c. extra.

STRUCTURAL STEEL SHAPES.

Store quotations are at 1.95c. to 2.00c., and mill prices are as follows: Beams and channels, 3 to 15 ins., inclusive, 1.78c.; angles, 3 to 6 ins., ¼ in. and heavier, 1.78c.; larger than 6 ins. on one or both legs, 1.88c.; beams, larger than 15 ins., 1.88c.; zees, 3 ins. and over, 1.78c.; tees, 3 ins. and over, 1.83c., in addition to the usual extras for cutting to extra lengths, punching, coping, bending and other shop work.

CAST IRON PIPE.

Quotations per net ton on water pipe, 4 ins., $27; 6 to 12 ins., $26; over 16 ins., $25; with $1 per ton extra for gas pipe.

CEMENT.

Good grade Portland cement, car lots..$1.65 per bbl.*

*(Four sacks per bbl. credited 10c. each when returned in good condition.)

SAND.

Bank sand, car lot	$0.75 per yd.
Torpedo sand, car lot	1.15 per yd.

CRUSHED STONE GRAVEL.

Crushed limestone, car lot	$1.05 per yd.
Crushed gravel, car lot	1.00 per yd.

Personal Mention

Mr. J. G. Gwyn, who has been acting chief engineer of the Denver & Rio Grande R. R., has been appointed chief engineer.

Mr. R. C. Harris, engineer of maintenance of way of the Toledo division of the Pennsylvania Lines West of Pittsburg, has been appointed engineer of maintenance of way of the Cleveland, Akron & Columbus Ry., succeeding Mr. A. B. Jones, resigned. Mr. Guy Scott succeeds Mr. Harris at Toledo and Mr. F. N. Crowell, engineer of maintenance of way of the Marietta division, becomes engineer of maintenance of way of the Richmond division. Mr. S. W. Hodgin succeeds Mr. Crowell on the Marietta division.

Mr. Bion J. Arnold, of Chicago, has been engaged by the Public Service Commission of the First district, New York state, to place a valuation upon all the street railway properties in the boroughs of Manhattan and the Bronx. Mr. Arnold and his assistants will begin the work of valuation at once.

Mr. J. T. Hallisey, chief train despatcher of the Intercolonial Ry. at Truro, N. S., has been appointed acting superintendent of the Halifax and St. John district, succeeding Mr. G. M. Jarvis, deceased.

Mr. J. H. Rosenstock, trainmaster of the Delaware & Hudson Co., at Carbondale, Pa., has resigned.

Mr. L. F. Boome, terminal trainmaster at Juarez for the Mexican Central Ry., has been appointed superintendent of the Torreon division with headquarters at Gomez Palacio, Durango, Mexico.

Mr. R. N. Begien has been promoted from assistant engineer of the Baltimore & Ohio R. R. at Baltimore, Md., to division engineer of the same road at Philadelphia, Pa., succeeding Mr. S. A. Jordan, promoted.

Mr. R. A. Bainbridge, assistant division engineer of the Canadian Pacific Ry. at Vancouver, B. C., has been appointed division engineer of the Esquimalt & Nanaimo, in charge of construction and maintenance, with headquarters at Victoria, B. C.

Chestnut Pole Preservation

ABOUT three and a half million poles are purchased annually in the United States for telephone, telegraph, electric light and street railway purposes. In 1906 out of a total of about 3,575,000 poles, 61 per cent. were cedar and 28 per cent. were chestnut.

Experiments were conducted by the Forest Service in co-operation with the American Telephone and Telegraph Company from August, 1905, to June, 1907. The data are contained in Circular 147 by George F. Weiss, chief, Section of Research. The conclusions as given in the circular are as follows:

The results of the experiments at Parkton corroborate, on the whole, those obtained from former investigations.

The rapid growth of chestnut, coupled with its other intrinsic qualities, renders it one of the best kinds of

wood for use as poles, and the demand for it will become of much greater importance in the future.

As the best poles come from sprout trees, care should be exercised in felling. It is sound policy for all pole users to encourage a careful system of cutting.

Soaking poles in water preparatory to preservative treatment is not recommended, as it results in no better absorption or penetration of the oil.

Incipient butt or top checks caused by careless cutting or natural defects should be treated with S-irons to prevent the poles from splitting. This applies especially to poles cut in spring and summer.

Chestnut poles seasoned for the periods given in Table 5 (summer cutting season, ship after 2 months; spring cutting season, ship after 3 months; winter cutting season, ship after 5 months; and autumn cutting season, ship after 7 months), will be dry enough for preservative treatment.

The sapwood of chestnut, which is a thin layer, should be completely saturated with the preservative. This can be accomplished by heating the poles in oil for six hours and leaving them in the cooling oil over night, or by heating them in hot oil for four hours and plunging them into cold oil for two hours.

Effectiveness of treatment is independent of the season of cutting, but depends directly upon the moisture content and the width of the sapwood. Chestnut poles cut during the period of maximum rate of diameter growth and thoroughly seasoned admit of best results in preservative treatment. Spring and summer cut poles reach such a condition more quickly than those cut in autumn and winter.

Western Society of Engineers

The board of directors of the Western Society of Engineers has ordered a new arrangement of quarters in the way of improved accommodations in the Monadnock Block, Chicago.

"The space heretofore occupied was a suite of offices on the east side of the building and known as Nos. 1734-41 inclusive. Under the new arrangements the rooms 1736-41 inclusive have been vacated and the new space includes all of the 17th floor north of the elevators, to the fire wall at the mid-length of the building. This includes the corridor, and the rooms on each side thereof, known as Nos. 1760-64 and 1731-35, inclusive. As shown on the plan, this gives a floor space of 62 ft. by 61.5 ft., an increase of more than 80 per cent over the old quarters.

"A wide double glass door will close the end of the corridor next the elevators and the present corridor walls will be taken out and rearranged. In the central portion of the new space will be the meeting room, 36 ft. by 44 ft., with a high ceiling and seats for 162—an increase of 60 per cent over the old quarters. It is expected that the ventilation of this new meeting room will be much better than heretofore. The reading room will remain and be virtually as heretofore, and with the secretary's office on the opposite side of the building, with an entrance vestibule between. Adjacent to these will be the library, on the east side, and a committee room and storeroom for periodicals on the west side of the building. This arrangement, it is believed, will give increased space for the needs and convenience of the library, which is steadily growing and is used more and more by the membership and the public."

Trade Notes

The Kellogg Switchboard & Supply Co., Chicago, have recently issued a bulletin describing their railway dispatching systems; also a bulletin describing the new Kellogg railway pole telephone, with supplements giving account of Kellogg railroad systems in successful operation. Some of the advantages of the Kellogg train dispatching systems are the safety, care and rapidity of train handling; the selective signaling of any or all stations and the services of telegraphers done away with. Experienced trainmen who have inspected the Kellogg railway pole telephone in actual service say that its reliability, simplicity and accurateness are its strongest features.

The Pierce Safety Appliance Co., Benwood, W. Va., has been incorporated with $500,000 capital stock by Franklin A. Pierce and Earl A. Lenkard, of Wheeling, W. Va.; William McSwain, Moundsville, W. Va., and others.

The Hanna Engineering Works, 820 Elston avenue, Chicago, announce that they have recently added the entire riveting business of the Quincy, Manchester, Sargent Co., Plainfield, N. J., including their full assortment of Pedrick & Ayer hydro-pneumatic, plain toggle "American" riveters, pneumatic punches, etc., and are now prepared to offer to the trade a variety of styles and sizes of riveters to meet the most exacting conditions, and fill the desire of such manufacturers as have a preference for a particular style of machine.

The Thomas Brace Rail Co., New York, has been organized to manufacture railroad rails and appliances, build railroads, mining, etc., with a capital of $2,000,000. The incorporators are E. T. Thomas, 115 Broadway; John Oehler, 87 Frankfort street, both of New York; W. A. Campbell, 247 New York avenue; T. H. Ross, 27 Madison street; C. B. Schellenberg, 220 Duffield street, all of Brooklyn.

John C. McMynn announces that he is now associated with Max Toltz, who has been with James J. Hill in various engineering capacities for the past 22 years. They have opened offices at 2014 Fisher building, Chicago, and are prepared to do a regular engineering business. Mr. Toltz makes a specialty of engineering work pertaining to railroads, both mechanical and civil, and can be consulted regarding any new devices, patents, etc. Mr. McMynn, having been mechanical engineer for Robert W. Hunt & Co. for the past 15 years, is prepared to take up the design and superintendence of steam, electric or other power plants, water plants, cement plants, testing, etc. Toltz & McMynn will make a specialty of economizing fuel and steam in plants now in operation and can furnish estimates of possible saving and cost of obtaining same.

The Kellogg Switchboard & Supply Co. have just issued their new bulletin describing in every detail their standard line of common battery apparatus. The bulletin is handsomely illustrated with large well finished half-tones. The "standard of excellence" Kellogg common battery wall telephones are described in full, with special descriptions of the new Kellogg "Short backboard" wall instruments, the new Kellogg "steel hotel set," and the new "indestructible desk stand" which is proving immensely popular.

BOOK DEPARTMENT (Continued)

EARTHWORK AND MASONRY AND ITS COST.

Specifications for Grading and Masonry for Railway Beds by W. Katte	.25
Table of Cubic Yards by S. B. Fisher	.25
Retaining-Walls for Earth by Malverd A. Howe	1.25
Earthwork and Its Cost by Halbert Powers Gillette	2.00
A Treatise on Masonry Construction by Ira O. Baker	5.00
A Method of Calculating the Cubic Contents of Excavations and Embankments by the Aid of Diagrams by J. C. Trautwine	2.00
Prismoidal Formulae and Earthwork by Thomas U. Taylor	1.50
Earth and Rock Excavation by C. Prelini	3.00
Tables for Calculating the Cubic Contents of Excavations and Embankments by John R. Hudson	1.00
Tunneling, Explosive Compounds, and Rock Drills by H. S. Drinker	25.00
Rock Excavation by Halbert Powers Gillette	3.00
Tunneling by C. Prelini, Additions by C. S. Hill	3.00
Ordinary Foundations by Charles Evan Fowler	
Railway and Other Earthwork Tables by Charles L. Crandall	1.50
Railroad Curves and Earthwork by C. F. Allen	2.00
Modern Stone-Cutting and Masonry by J. S. Siebert	1.50
Improvements of Rivers by B. F. Thomas	6.00
Design and Construction of Dams by E. Wegmann	5.00
Treatise on Roads and Pavements by I. O. Baker	5.00
Highway Construction by A. T. Byrne	5.00
City Roads and Pavements Suited to Cities of Moderate Size by W. P. Judson	2.00
Earth Dams by Burr Bussell	1.00
Earthwork Tables by H. S. Henderson	1.00

VENTILATION, HEATING, SEWERAGE.

The Heating and Ventilation of Buildings by R. C. Carpenter	4.00
Tables and Diagrams for Making Estimates for Sewerage Work by S. M. Swaab	.50
British Sewerage Works by M. N. Baker	2.00
Ventilation and Heating by John S. Billings	4.00
Electric Heating by E. J. Houston and A. E. Kennelly	1.00
American Plumbing Practice by	2.50
Cleaning and Sewerage of Cities by Prof. R. Baumeister	2.00
Dimensions of Pipes, Fittings and Valves by W. D. Browning	.75
Steam Heating and Ventilation by William S. Monroe	2.00
Sewerage Work Analyses by C. J. Fowler	2.00

ELECTRICITY, DYNAMOS, MOTORS.

The Induction Motor by B. A. Behrend	1.50
The Induction Motor; Its Theory and Design by Boy de la Tour	2.50
Power Distribution for Electric Railways by Louis Bell	2.50
Electric Power Transmission by Louis Bell	4.00
Long Distance Electric Power Transmission by R. W. Hutchinson, Jr.	
Electricity One Hundred Years Ago and To-day by E. J. Houston	1.00
Electric Transmission of Water Power by Alton D. Adams	3.00
Electric-Dynamic Machinery by E. J. Houston and A. E. Kennelly	2.50
High Tension Power Transmission by	3.00
Berlin-Zossen Electric Railway Tests of 1903 by Louis Bell	3.00
Recent Types of Dynamo-Electric Machinery by Edwin J. Houston and A. E. Kennelly	4.00
Electrical Engineering Leaflets, Containing the Underlying Principles of Electricity and Magnetism by Edwin J. Houston and A. E. Kennelly. In three grades as follows:	
Elementary Grade	1.50
Intermediate Grade	1.50
Advanced Grade	1.50
Practical Calculation of Dynamo-Electric Machines by A. E. Wiener	3.00
Original Papers on Dynamo-Machinery and Allied Subjects by John Hopkinson	1.00
The Electric Motor by Edwin J. Houston and A. E. Kennelly	1.00
Alternating Electric Currents by E. J. Houston and A. E. Kennelly	1.00
The Theory and Calculation of Alternating Current Phenomena by Charles Proteus Steinmetz	4.00
The Art of Illumination by Louis Bell	2.50
Electric Arc Lighting by Edwin J. Houston and A. E. Kennelly	1.00
Electric Lighting Specifications by E. A. Merrill	1.50
Electric Incandescent Lighting by Edwin J. Houston and A. E. Kennelly	1.00
Modern Electric Railway Motors by George T. Hancheft.	2.00
The Universal Wiring Computer by Carl Hering	1.00
Electricity and Magnetism by C. P. Steinmetz	2.50
Shop and Road Testing of Dynamos and Motors by E. C. Parham and J. C. Shedd	2.50
Spangenberg's Steam and Electrical Engineering by Messrs. E. Spangenberg, A. Uhl, and E. W. Pratt	3.50
Storage-Battery Engineering by Lamar Lyndon	3.00
Magnetism by Edwin J. Houston and A. E. Kennelly	1.00
Alternating Current Wiring and Distribution by William Leroy Emmet	1.00
Experiments with Alternate Currents of High Potential and High Frequency by Nikola Tesla	1.00
Alternating Current Transformer by F. G. Baum	1.50
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